Examples & Lessons Learned...
...from the BST Capacity Building Program

United Nations / Brazil Symposium on Basic Space Technology

“Creating Novel Opportunities with Small Satellite Space Missions”

Natal, Brazil

11 – 14 September 2018
Berlin Space Technologies
Who we are

- Provides system solutions based on small satellites & the leading German “new space” company
- Implementing large scale mass manufacturing together with Azista Aerospace

- Experience:
  - Participated in 15 missions with 50+ satellites
- 1000 sqm labs & facilities in Berlin
- R&D focus on mass manufacturing

Tom Segert, Björn Danziger & Matthias Buhl
Berlin Space Technologies
What we do

Mass manufacturing of satellite sub systems

Design & manufacturing of demanding payloads

Satellite systems & solutions

Ground segment & GSE

In orbit demonstration service

Capacity building

Vertically integrated to provide full satellites systems & solutions
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Our programs

Kent-Ridge-1B (BST: 2015-2016)
NExSat (BST: 2015-2018)
Lagari (BST: 2017-2019)
LEOS-100 (Azista & BST: 2019+)

Level 1B
Level 2B
Level 3A

Heritage Programs
(BST KP*: 2004-2009)

Satellite Subsystems
(BST: 2012-2018)

UrtheCast: Space Station
(BST: 2012-2014)

AIW & Operation
Technology
Subsystems

ESA OPSSat
ESA TRISAT
CNES PICSAT
Aalto-1

ISRO INS-1A
ISRO INS-1B
SATCOM

2x Star Tracker, 6x IMU

*) by BST Key Personnel before foundation of BST
Why capacity building?

Intention of the customer
- Started out as a consumer
- Aims to be part of the global space community
- Has ambitious goals to inspire generations

Need of customer: a well trained workforce
- Great need for vocationally trained engineers
- Excellence is should be sustainable & homegrown
- Meaningful space education sets the path

Berlin Space Technologies is an experienced partner
- Sound training model
- Excellent track record
- Meaningful satellite missions

Let's work together to make today’s dreams tomorrows reality!
Level 0
Client engineers operate a turn key satellite independently

Level 1
Client engineers are participate building the satellite at host’s lab.

Level 2
Client engineers design & build satellite on system level in their own labs while buying key subsystems from foreign suppliers.

Level 3
Client engineers build & design key subsystems & the whole system independently in their own labs.
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BST approach

➢ Multi step instead of one giant leap
➢ Training adjusted to trainee capabilities
➢ Building up client labs in parallel to program
➢ Business model that supports success

Design of 1st Satellite

Design of 2nd satellite
Design of 3rd satellite

Building labs & infrastructure
Operating 1st satellite
Operating 2nd satellite

Subsystem Training
Replacing foreign parts

In Berlin
At client labs

Year 1
Year 2
Year 3
Year 4
Year 5
## Berlin Space Technologies

### Example training programs from BST experience

<table>
<thead>
<tr>
<th>Mission</th>
<th>Kent Ridge 1 / 1B</th>
<th>NExSat</th>
<th>Satellite Factory</th>
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</thead>
<tbody>
<tr>
<td>Client</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>NUS</td>
<td>National University of Singapore</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Azista [Logo]</td>
</tr>
<tr>
<td>Type</td>
<td>System training &amp; AIT (Level 1)</td>
<td>Components &amp; support (Level 2)</td>
<td>Full tech transfer (Level 3)</td>
</tr>
<tr>
<td>Participants</td>
<td>7</td>
<td>10+</td>
<td>20+</td>
</tr>
<tr>
<td>Scope</td>
<td>University satellite</td>
<td>Experimental satellite series</td>
<td>Mass manufacturing of satellites</td>
</tr>
<tr>
<td>Timeline</td>
<td>2013-2016</td>
<td>2015-2019</td>
<td>2018-</td>
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</tbody>
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Level 1 training program

National University of Singapore together with Berlin Space Technologies built a sustainable space program.

1st satellite in Space. 2nd under construction in Singapore

Summary
➢ 12 months of training

1. 6 months university training
2. 6 months industry training

➢ Two satellites built

Lessons learned
A training program should have a simple mission & a relaxed schedule

1. have two satellites; one to be launched & one kit or flatsat - is very helpful.
2. for the client: keep team focused & committed for 2nd mission
Summary
➢ Delivery of components only
➢ Client responsible for system design & system AIV
➢ Laboratories built by 3rd party

Lessons learned
1. Program continuity very important for program success.
2. Teams should not have too much time between 1st & 2nd satellite otherwise brain drain might deteriorate capabilities.
3. BST programs usually already include 2nd satellite
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Level 3 training program

Summary
➢ Joint venture for satellite mass manufacturing
➢ Covers all BST systems & subsystems
➢ Laboratories currently under construction (opening 2019)
  ➢ 10,000m² facility
  ➢ 150 engineers
  ➢ Capacity of 100+ satellites per year
➢ BST is one of the few players willing & able to do a full level 3 program

Implementing Satellite Mass Manufacturing for Mega Constellations
Berlin Space Technologies
Conclusion

Berlin Space Technologies is;

- An experienced provider of capacity building
- Has successfully done all levels of capacity building
- One of the few players who can offer full Level 3 programs

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Berlin Space Technologies
Best Practice in Capacity Building (Panel Session)